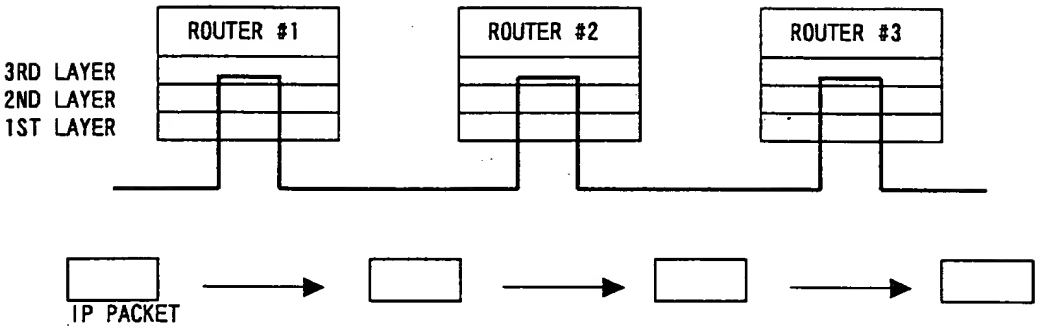
ROUTER #1
ROUTER #2
ROUTER #3
3RD LAYER
2ND LAYER
1ST LAYER
IP PACKET

FIG. 1A

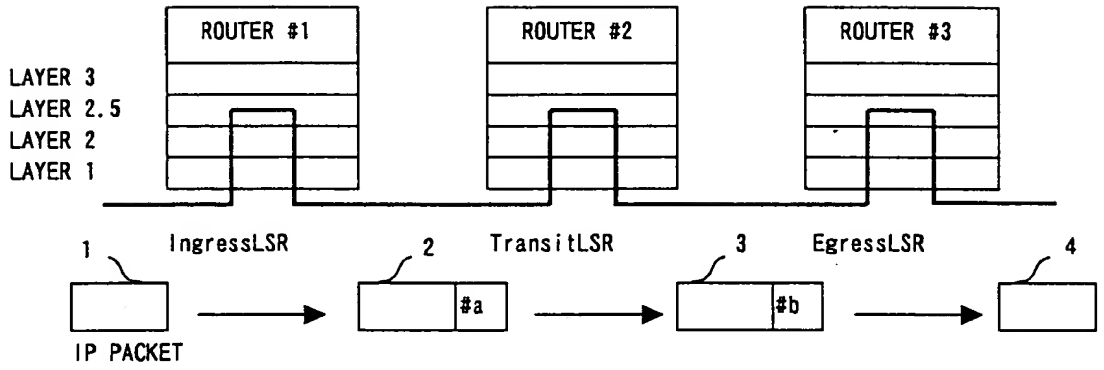
ROUTER #1
ROUTER #2
ROUTER #3
LAYER 3
LAYER 2.5
LAYER 2
LAYER 1
1
IngressLSR
2
TransitLSR
3
EgressLSR
4
#a
#b
IP PACKET

FIG. 1B

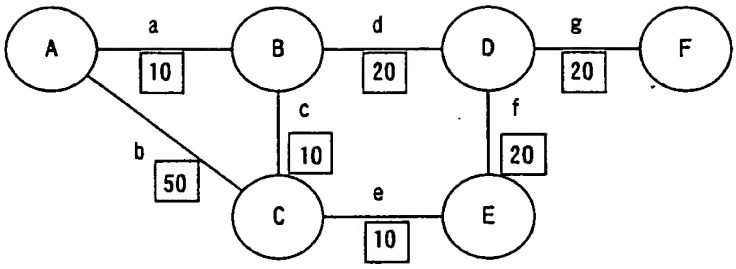

FIG. 1C

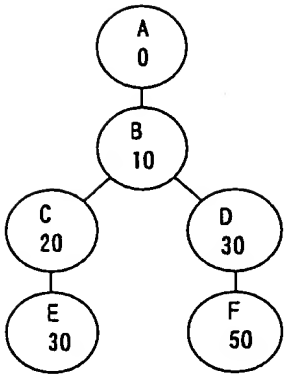

FIG. 1D

DESTINATION NETWORK	NEXT HOP	COST
a	—	1
b	—	1
c	B	2
d	B	2
e	C	2
f	B	3
g	B	3

FIG. 1E

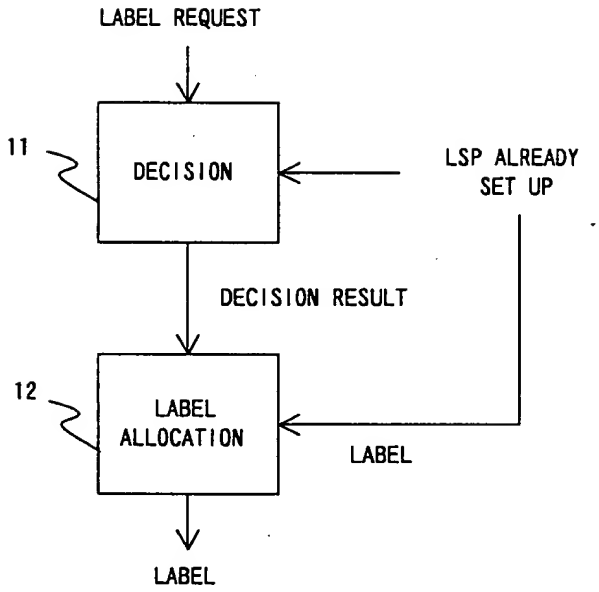
LABEL REQUEST
11
DECISION
LSP ALREADY SET UP
DECISION RESULT
12
LABEL ALLOCATION
LABEL
LABEL

FIG. 2

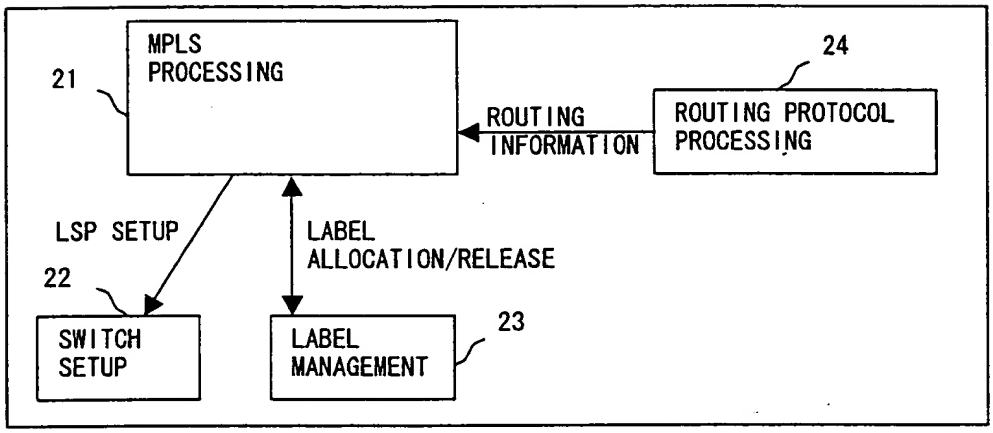
MPLS
PROCESSING
21
24
ROUTING PROTOCOL
PROCESSING
ROUTING
INFORMATION
LSP SETUP
LABEL
ALLOCATION/RELEASE
22
SWITCH
SETUP
LABEL
MANAGEMENT
23

FIG. 3A

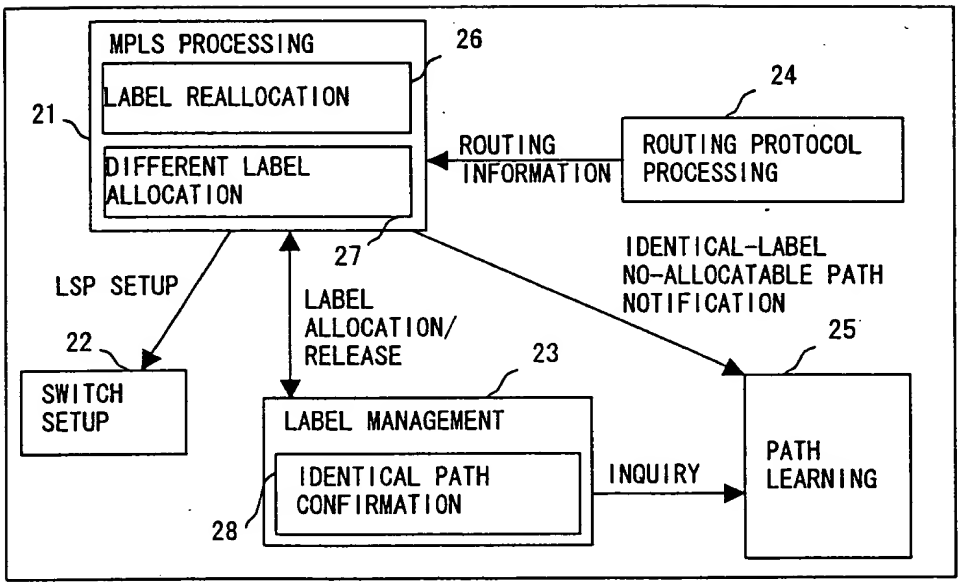
MPLS PROCESSING
26
LABEL REALLOCATION
21
DIFFERENT LABEL ALLOCATION
24
ROUTING INFORMATION
ROUTING PROTOCOL PROCESSING
27
IDENTICAL-LABEL NO-ALLOCATABLE PATH NOTIFICATION
LSP SETUP
LABEL ALLOCATION/ RELEASE
22
25
23
SWITCH SETUP
LABEL MANAGEMENT
IDENTICAL PATH CONFIRMATION
INQUIRY
PATH LEARNING
28

FIG. 3B

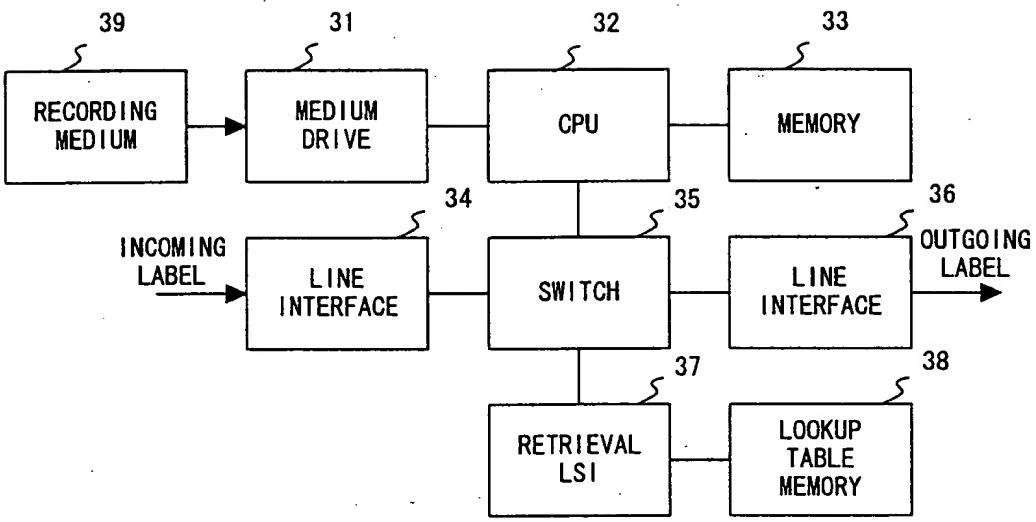
39
31
32
33
RECORDING MEDIUM
MEDIUM DRIVE
CPU
MEMORY
34
35
36
INCOMING LABEL
LINE INTERFACE
SWITCH
LINE INTERFACE
OUTGOING LABEL
37
38
RETRIEVAL LSI
LOOKUP TABLE MEMORY

FIG. 4

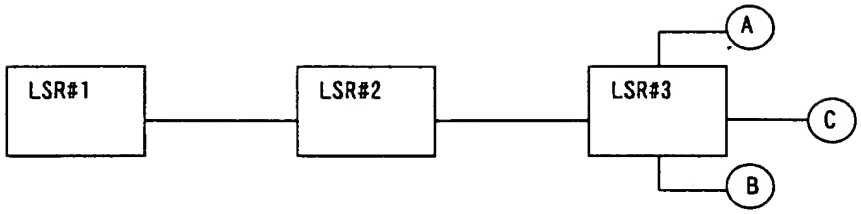

FIG. 5

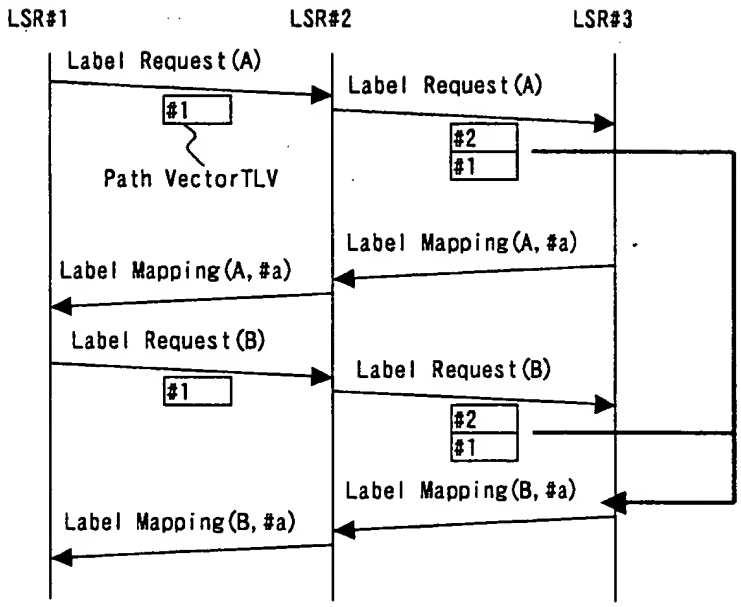
LSR#1
LSR#2
LSR#3
Label Request(A)
#1
Path VectorTLV
Label Request(A)
#2
#1
Label Mapping(A, #a)
Label Mapping(A, #a)
Label Request(B)
#1
Label Request(B)
#2
#1
Label Mapping(B, #a)
Label Mapping(B, #a)

FIG. 6

	LABEL	PATH	FEC
LSR#1	—	—	—
LSR#2	—	—	—
LSR#3	#a	#1−#2−#3	A

FIG. 7

	INCOMING LABEL	OUTGOING LABEL
LSR#1	—	#a
LSR#2	#a	#a
LSR#3	#a	—

FIG. 8

	LABEL	PATH	FEC
LSR#1	—	—	—
LSR#2	—	—	—
LSR#3	#a	#1−#2−#3	A, B

FIG. 9

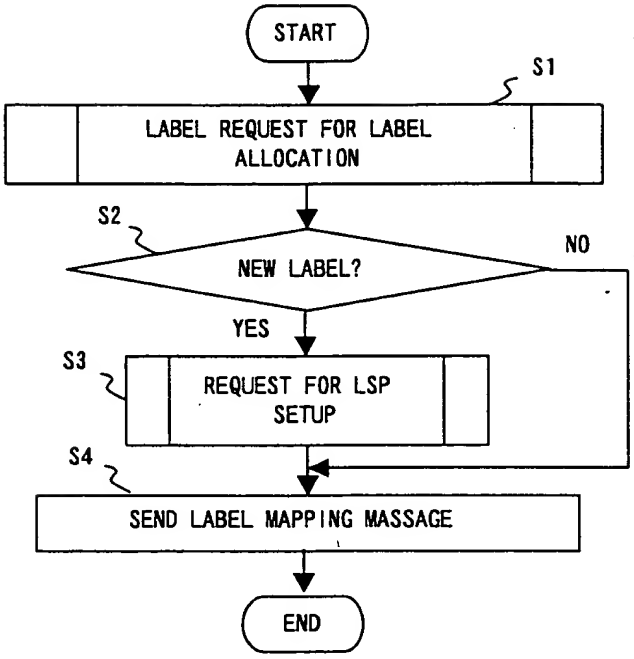
START
S1
LABEL REQUEST FOR LABEL ALLOCATION
S2
NEW LABEL?
NO
YES
S3
REQUEST FOR LSP SETUP
S4
SEND LABEL MAPPING MASSAGE
END

FIG. 10

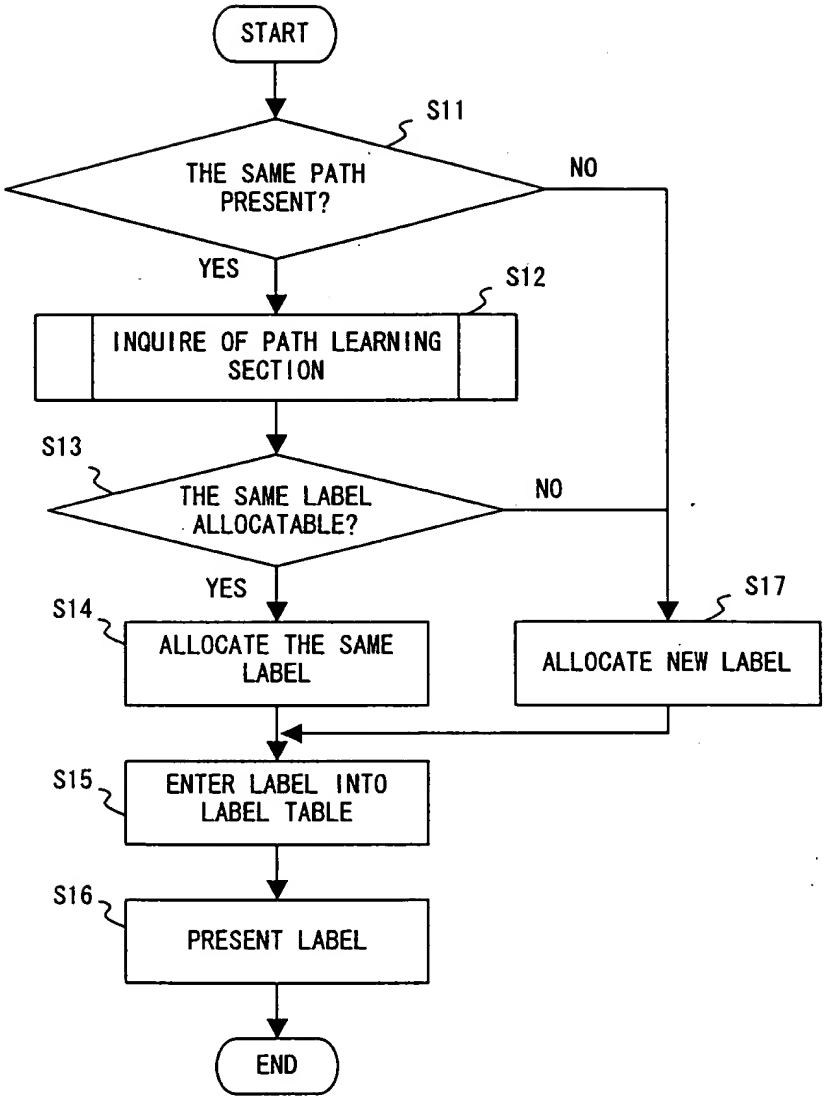
START
S11
THE SAME PATH PRESENT?
NO
YES
S12
INQUIRE OF PATH LEARNING SECTION
S13
THE SAME LABEL ALLOCATABLE?
NO
YES
S14
ALLOCATE THE SAME LABEL
S17
ALLOCATE NEW LABEL
S15
ENTER LABEL INTO LABEL TABLE
S16
PRESENT LABEL
END

FIG. 11

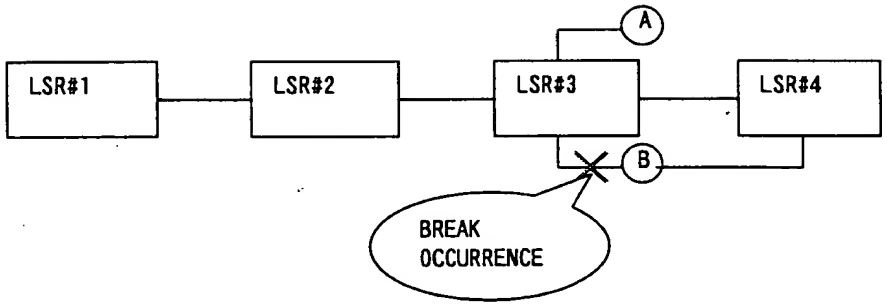

FIG. 12

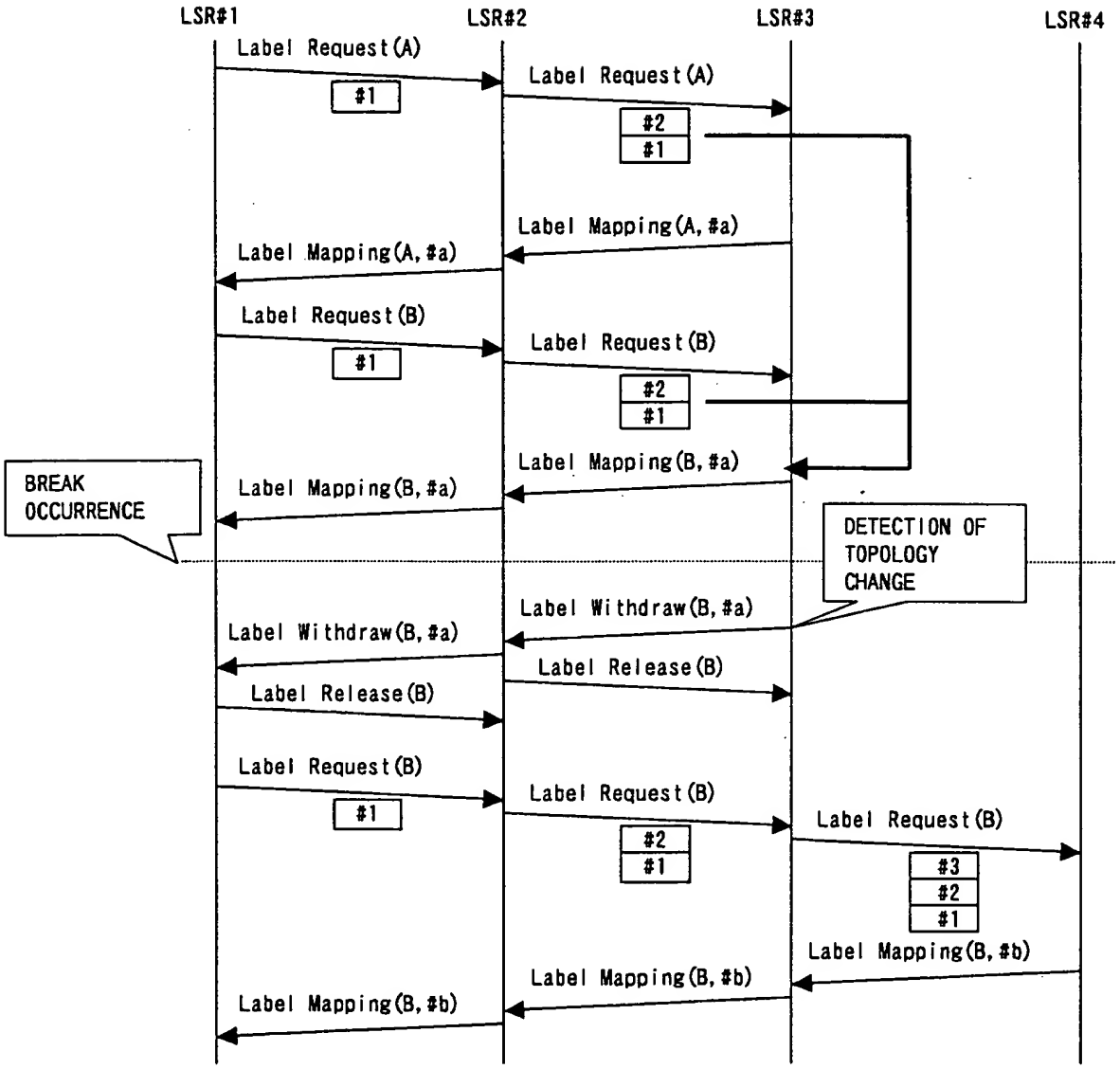
LSR#1
LSR#2
LSR#3
LSR#4
Label Request(A)
#1
Label Request(A)
#2
#1
Label Mapping(A, #a)
Label Mapping(A, #a)
Label Request(B)
#1
Label Request(B)
#2
#1
Label Mapping(B, #a)
BREAK OCCURRENCE
Label Mapping(B, #a)
DETECTION OF TOPOLOGY CHANGE
Label Withdraw(B, #a)
Label Withdraw(B, #a)
Label Release(B)
Label Release(B)
Label Request(B)
#1
Label Request(B)
#2
#1
Label Request(B)
#3
#2
#1
Label Mapping(B, #b)
Label Mapping(B, #b)
Label Mapping(B, #b)

FIG. 13

	LABEL	PATH	FEC
LSR#1	—	—	—
LSR#2	—	—	—
LSR#3	#a	#1−#2−#3	A, B
LSR#4	—	—	—

FIG. 14

	INCOMING LABEL	OUTGOING LABEL
LSR#1	—	#a
LSR#2	#a	#a
LSR#3	#a	—
LSR#4	—	—

FIG. 15

	LABEL	PATH	FEC
LSR#1	—	—	—
LSR#2	—	—	—
LSR#3	#a	#1−#2−#3	A
LSR#4	—	—	—

FIG. 16

LABEL	FEC
#a	A, B

FIG. 17

	LABEL	PATH	FEC
LSR#1	—	—	—
LSR#2	—	—	—
LSR#3	#a	#1−#2−#3	A
LSR#4	#b	#1−#2−#3−#4	B

FIG. 18

	INCOMING LABEL	OUTGOING LABEL
LSR#1	—	#a
	—	#b
LSR#2	#a	#a
	#b	#b
LSR#3	#a	—
	#b	#b
LSR#4	—	—
	#b	—

FIG. 19

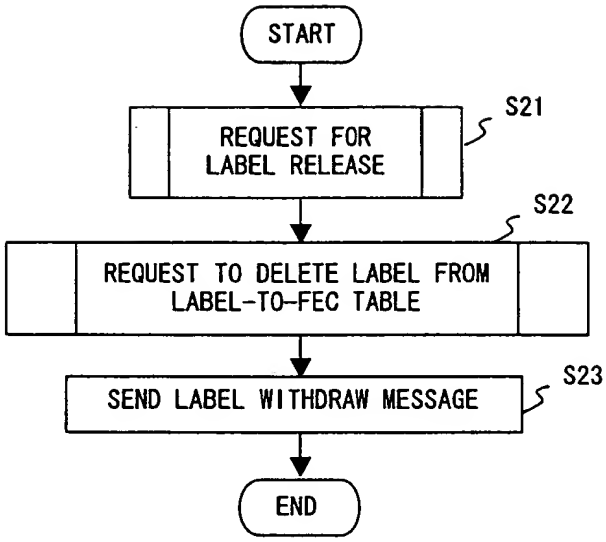
START
REQUEST FOR LABEL RELEASE
S21
REQUEST TO DELETE LABEL FROM LABEL-TO-FEC TABLE
S22
SEND LABEL WITHDRAW MESSAGE
S23
END

FIG. 20

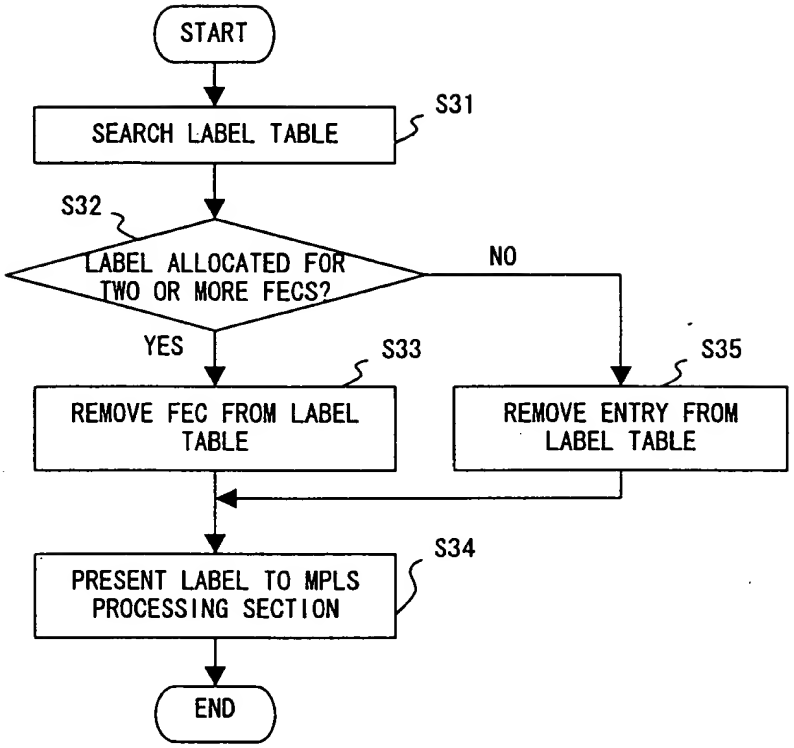
START
SEARCH LABEL TABLE
S31
S32
LABEL ALLOCATED FOR TWO OR MORE FECS?
NO
YES
S33
S35
REMOVE FEC FROM LABEL TABLE
REMOVE ENTRY FROM LABEL TABLE
S34
PRESENT LABEL TO MPLS PROCESSING SECTION
END

FIG. 21

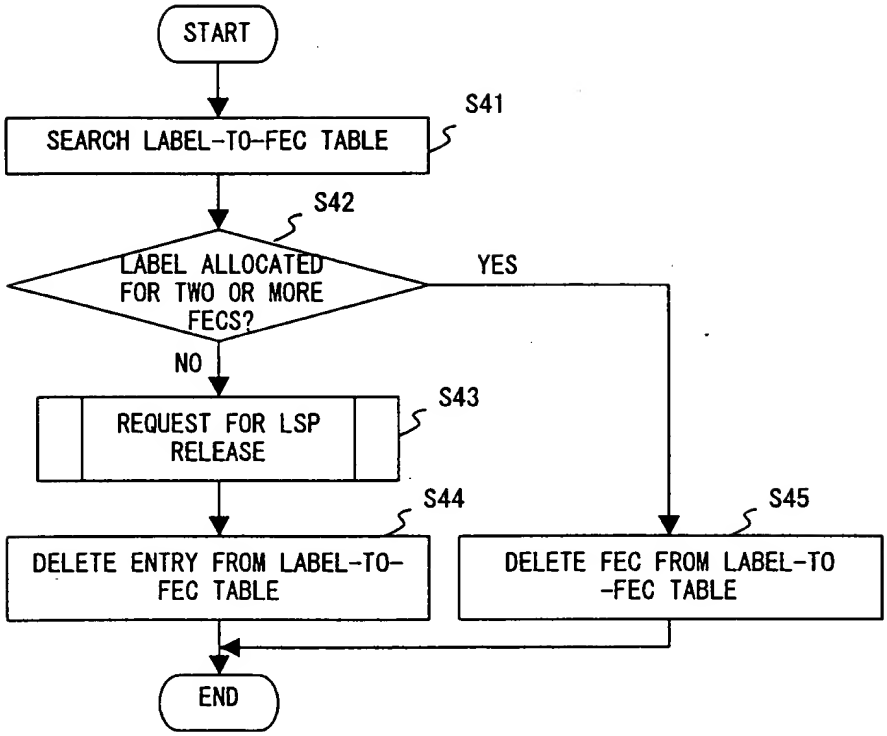
START
S41
SEARCH LABEL-TO-FEC TABLE
S42
LABEL ALLOCATED FOR TWO OR MORE FECS?
YES
NO
S43
REQUEST FOR LSP RELEASE
S44
DELETE ENTRY FROM LABEL-TO-FEC TABLE
S45
DELETE FEC FROM LABEL-TO-FEC TABLE
END

FIG. 22

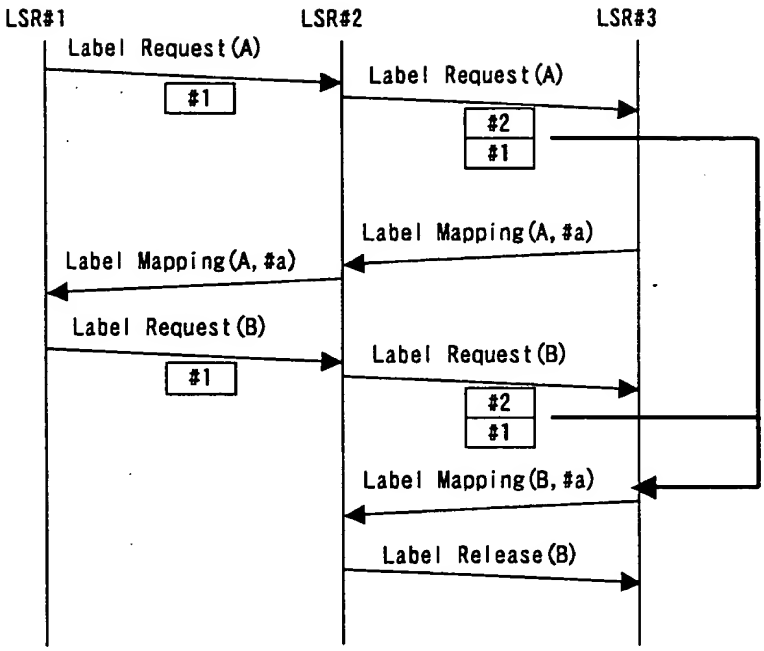
LSR#1
LSR#2
LSR#3
Label Request(A)
#1
Label Request(A)
#2
#1
Label Mapping(A, #a)
Label Mapping(A, #a)
Label Request(B)
#1
Label Request(B)
#2
#1
Label Mapping(B, #a)
Label Release(B)

FIG. 23

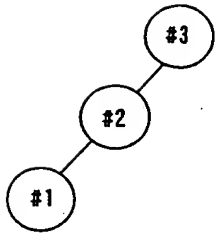

FIG. 24

	LABEL	PATH	FEC
LSR#1	—	—	—
LSR#2	—	—	—
LSR#3	#a	#1−#2−#3	A
	#b	#1−#2−#3	B

FIG. 25

	INCOMING LABEL	OUTGOING LABEL
LSR#1	—	#a
	—	#b
LSR#2	#a	#a
	#b	#b
LSR#3	#a	—
	#b	—

FIG. 26

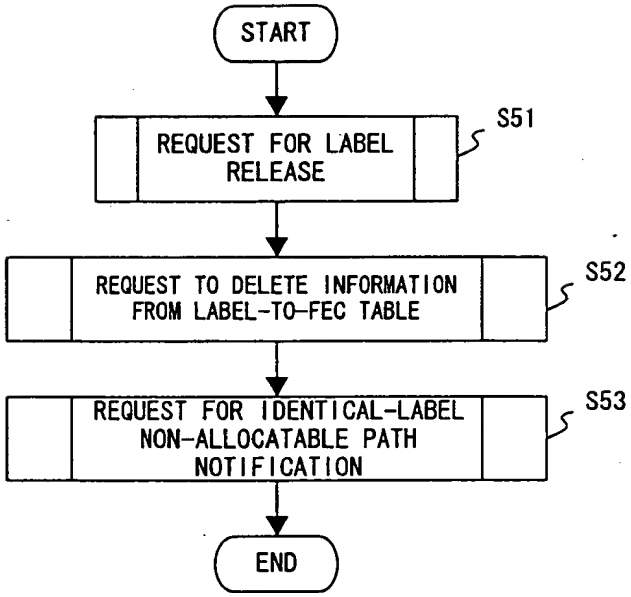
START
REQUEST FOR LABEL RELEASE
S51
REQUEST TO DELETE INFORMATION FROM LABEL-TO-FEC TABLE
S52
REQUEST FOR IDENTICAL-LABEL NON-ALLOCATABLE PATH NOTIFICATION
S53
END

FIG. 27

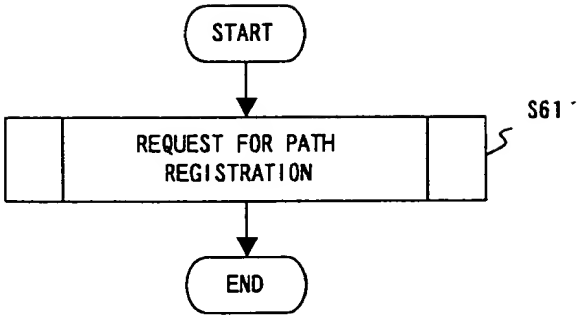

FIG. 28

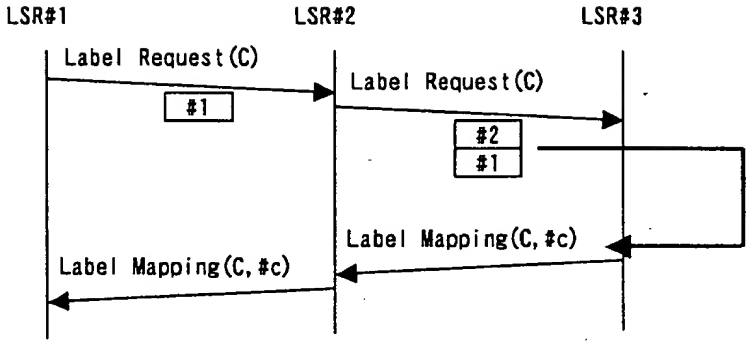
LSR#1
LSR#2
LSR#3
Label Request(C)
#1
Label Request(C)
#2
#1
Label Mapping(C, #c)
Label Mapping(C, #c)

FIG. 29

	LABEL	PATH	FFC
LSR#1	—	—	—
LSR#2	—	—	—
LSR#3	#a	#1−#2−#3	A
	#b	#1−#2−#3	B
	#c	#1−#2−#3	C

FIG. 30

	INCOMING LABEL	OUTGOING LABEL
LSR#1	—	#a
	—	#b
	—	#c
LSR#2	#a	#a
	#b	#b
	#c	#c
LSR#3	#a	—
	#b	—
	#c	—

FIG. 31

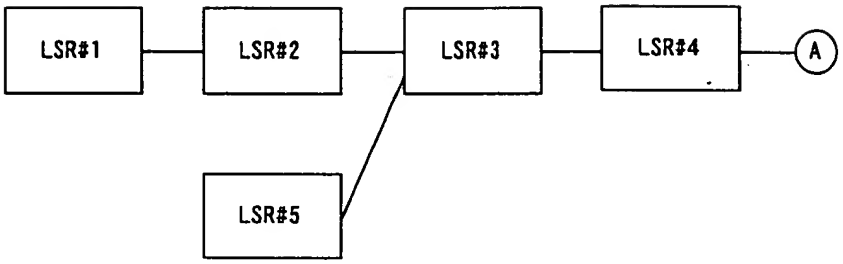

FIG. 32

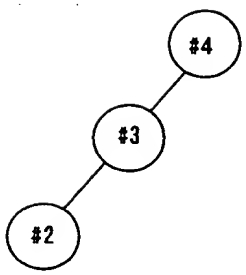

FIG. 33

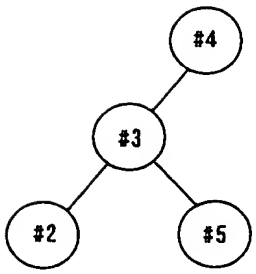

FIG. 34

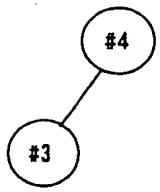

FIG. 35

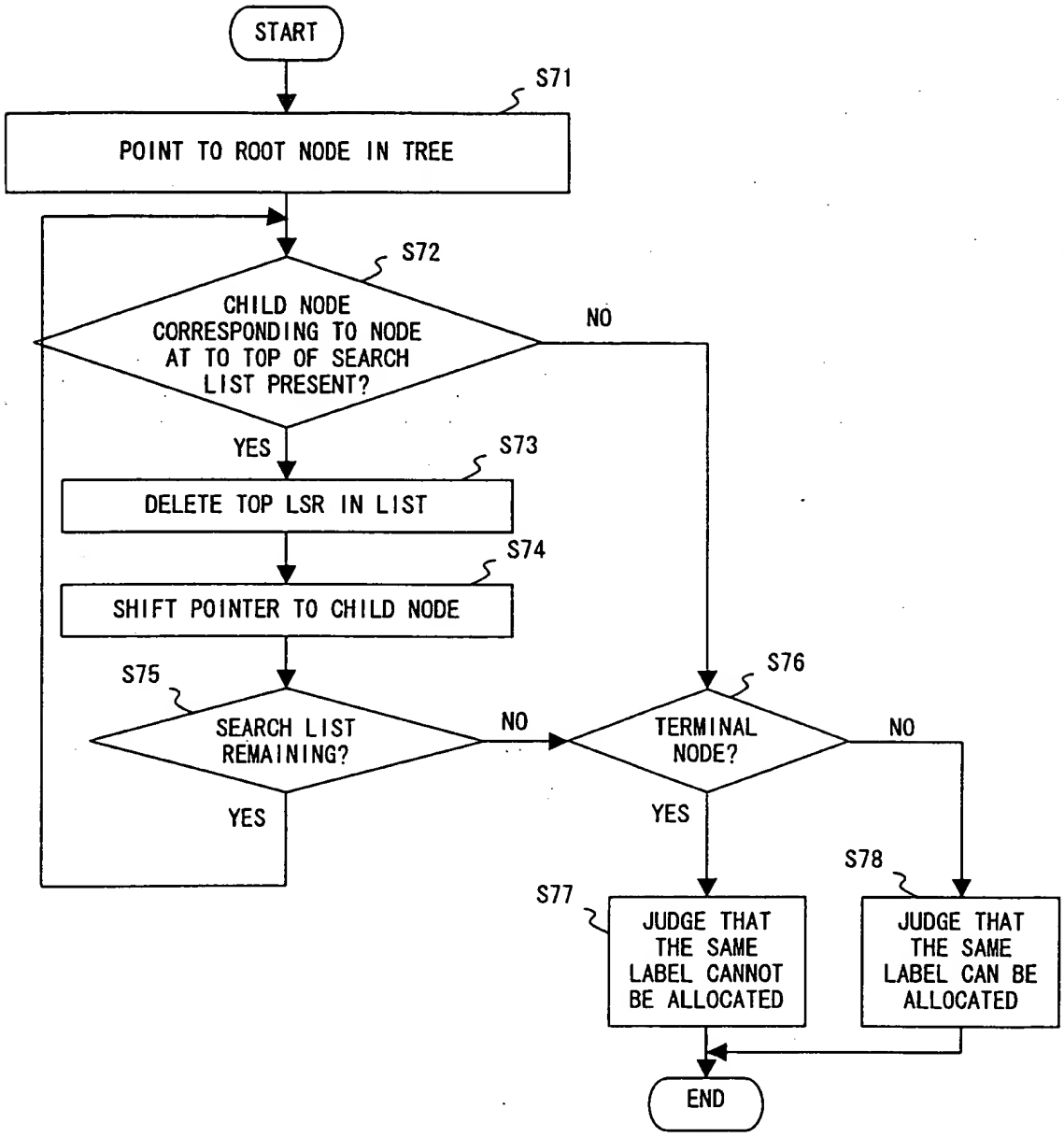
START
S71
POINT TO ROOT NODE IN TREE
S72
CHILD NODE CORRESPONDING TO NODE AT TO TOP OF SEARCH LIST PRESENT?
NO
YES
S73
DELETE TOP LSR IN LIST
S74
SHIFT POINTER TO CHILD NODE
S75
SEARCH LIST REMAINING?
NO
YES
S76
TERMINAL NODE?
NO
YES
S77
JUDGE THAT THE SAME LABEL CANNOT BE ALLOCATED
S78
JUDGE THAT THE SAME LABEL CAN BE ALLOCATED
END

FIG. 36

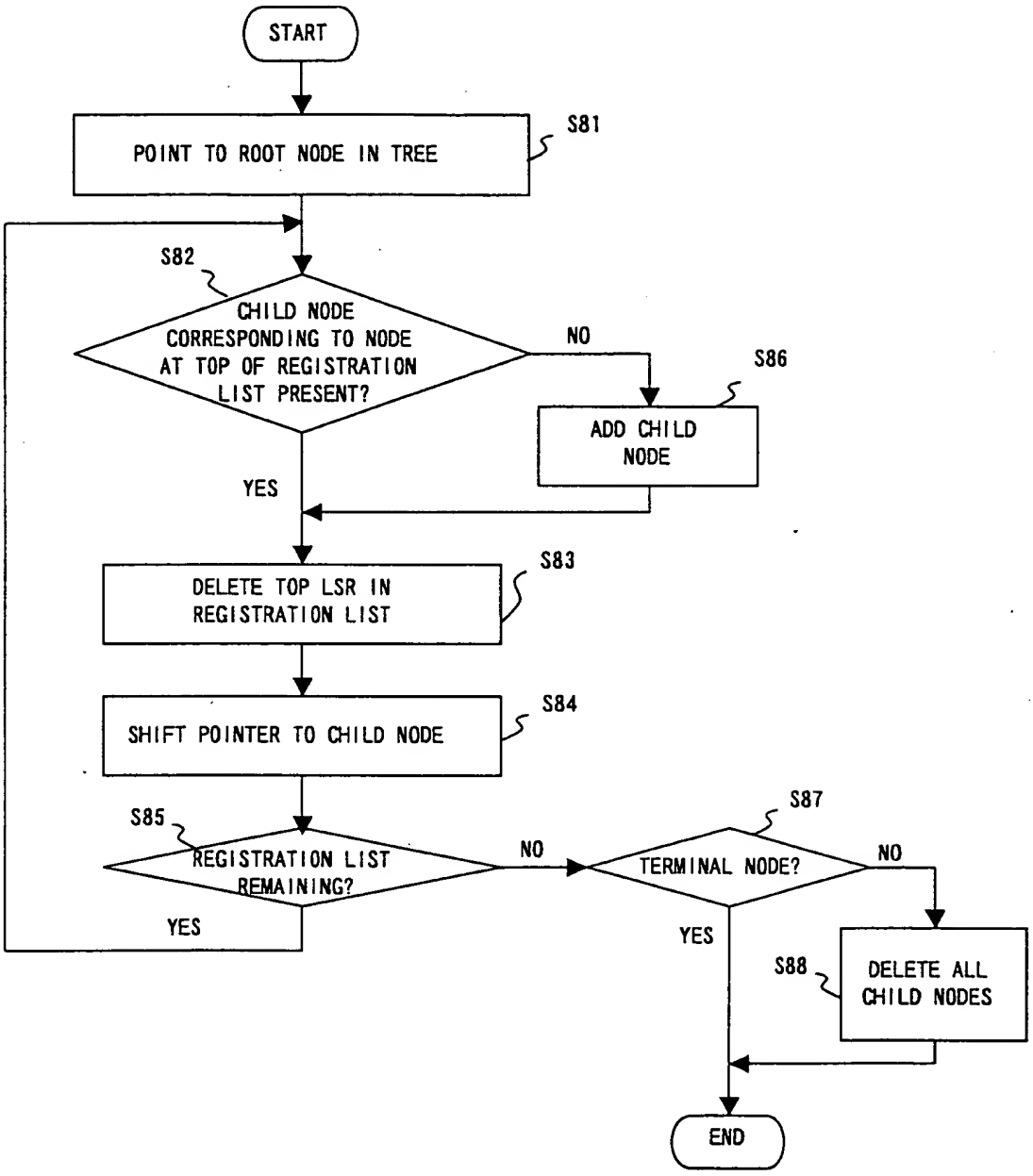
START
POINT TO ROOT NODE IN TREE
S81
S82
CHILD NODE CORRESPONDING TO NODE AT TOP OF REGISTRATION LIST PRESENT?
NO
S86
ADD CHILD NODE
YES
S83
DELETE TOP LSR IN REGISTRATION LIST
S84
SHIFT POINTER TO CHILD NODE
S85
REGISTRATION LIST REMAINING?
NO
S87
TERMINAL NODE?
NO
YES
YES
S88
DELETE ALL CHILD NODES
END

FIG. 37

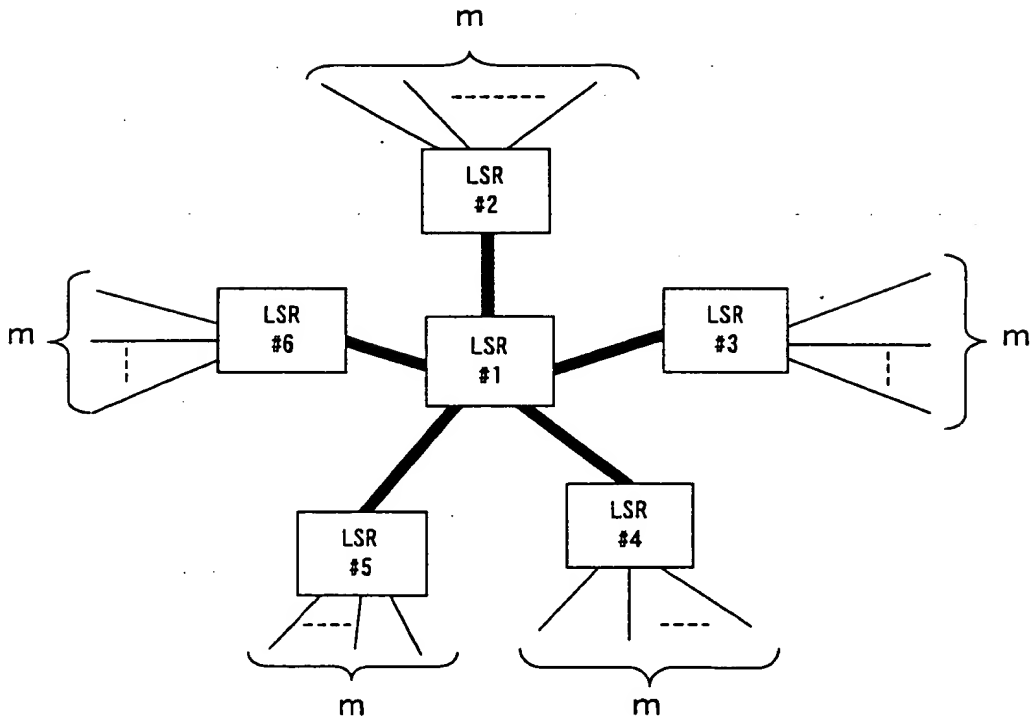

FIG. 38

LSP NUMBERS	10	20	30	40	50
CONVENTIONAL TECHNIQUE	1917	8987	21257	38727	61397
INVENTION	90	380	870	1560	2450
CONVENTIONAL TECHNIQUES/INVENTION(a)	21.3	23.7	24.4	24.8	25.1

FIG. 39.

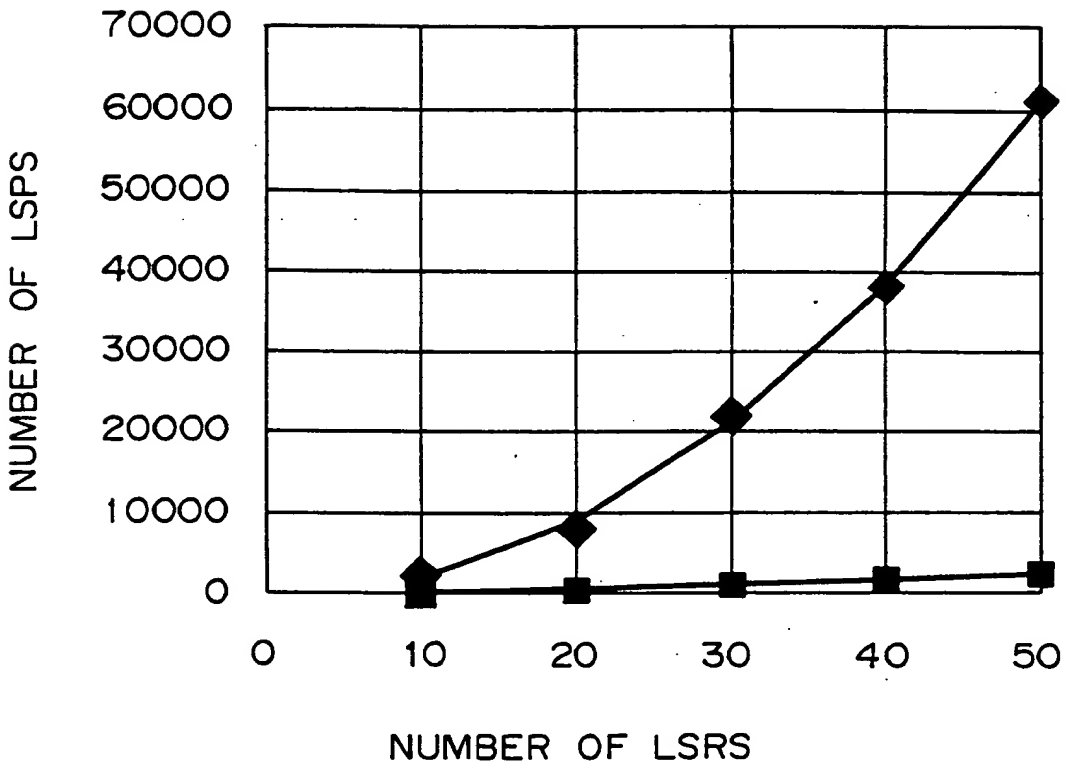
70000
60000
50000
40000
30000
20000
10000
0
NUMBER OF LSPS
0
10
20
30
40
50
NUMBER OF LSRS

FIG. 40

LSR NUMBERS	10	20	30	40	50
CONVENTIONAL TECHNIQUES	7362	34732	82302	150072	238042
INVENTION	90	380	870	1560	2450
CONVENTIONAL TECHNIQUES/INVENTION(a)	81.8	91.4	94.6	96.2	97.2

FIG. 41.

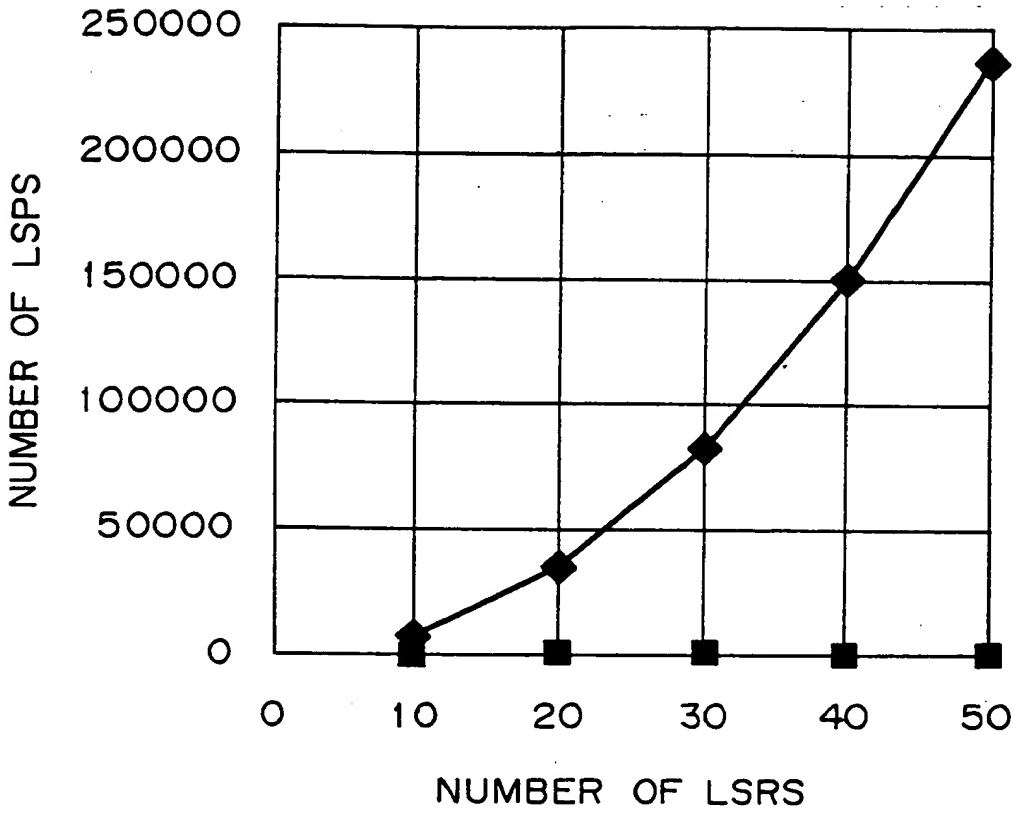
250000
200000
150000
100000
50000
0
NUMBER OF LSPS
0
10
20
30
40
50
NUMBER OF LSRS

FIG. 42